

NAVIGATION TERMINAL, NAVIGATION SYSTEM, NAVIGATION PROGRAM  
AND DRIVE GUIDE METHOD

CROSS REFERENCE OF RELATED APPLICATION

5        This application is based on and claims priority under  
35 U.S.C. §119 with respect to Japanese Patent Application  
No. 2002-268373 filed on September 13, 2002, the entire content  
of which is incorporated herein by reference.

10        BACKGROUND OF THE INVENTION

The present invention relates to a navigation terminal  
mounted on a mobile unit, and more particularly to a navigation  
system including a terminal.

15        A car navigation system that is mounted on a vehicle that  
is a typical mobile unit displays a map on display unit, based  
on a current location of the vehicle positioned, with a mark  
indicating the current location of the self vehicle superposed  
on its map.

20        In the car navigation system, a positioning unit for  
positioning the current location of the vehicle includes a GPS  
(Global Positioning System) receiver and various  
self-contained navigation sensors for calculating the current  
location from the travel distance and the moving direction of  
the vehicle. Also, the map information for displaying a map  
25        on the display unit, the relevant information associated with

the map information and various kinds of functional services are provided from an information center located outside the vehicle, employing a communication unit mounted on the vehicle.

There is a functional service as above described such  
5 that the information indicating the place of destination and the information indicating the current location as the place of departure are transmitted via a communication unit from a terminal mounted on the vehicle to the information center, and the information center searches a drive route on the basis of  
10 the received information, whereby the drive route information indicating the searched drive route is transmitted again via the communication unit from the information center to the terminal. In such a route searching functional service, when the terminal mounted on the vehicle receives the drive route  
15 information, it does not always follow that the total drive route information indicating the drive route connecting the place of departure and the place of destination is received at a time.

As an example in which the total drive route information  
20 is not received, the communication line connecting the terminal and the information center may be disconnected at the time of receiving data while the mobile unit is driven. Also, as another example, the information amount of total drive route information may exceed the storage capacity of the storage unit provided  
25 for the terminal.

In this manner, when the total drive route information is not received, the drive guide is not given, making it impossible to support the driving fully.

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#### SUMMARY OF THE INVENTION

In order to solve the above problems, the present invention provides a navigation terminal including a positioning unit for positioning a current location of a mobile unit, a setting unit for setting up a place of departure and a place of destination, a communication unit for transmitting and receiving information to and from an information center, a temporary storage unit for storing the drive route information received by the communication unit, and a drive guide unit for guiding the driving on the basis of the current location positioned by the positioning unit and the drive route information stored in the temporary storage unit, wherein when the drive route information received by the communication unit is the information of a partial drive route in the total drive route connecting the place of destination and the place of departure that are set up by the setting unit, the guide unit starts the drive guide on the basis of the received information of the partial drive route.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and advantages of this invention

will become more fully apparent from the following detailed description taken with the accompanying drawings in which:

Fig. 1 is a block diagram of the navigation system according to an embodiment of the present invention;

5        Fig. 2 is a flowchart of the navigation system according to the embodiment of the invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 1, an embodiment of the present invention  
10        will be described below. This embodiment involves a navigation system employing a navigation terminal of the invention.

In Fig. 1, numeral 10 denotes the navigation terminal mounted on the vehicle that is a mobile unit. The navigation terminal 10 includes a display unit 11, a communication unit  
15        12, a control unit 13 that functions as a display control unit for controlling the display unit 11, functions as a connection control unit for controlling the communication unit 12, and functions as a drive guide unit for guiding the driving on the basis of the drive route guide information as will be described  
20        later, a positioning unit 14 for positioning the current location of the vehicle, and an operation unit 18 for enabling the user to input a designation for the place of destination or a search instruction for the route. Also, the communication unit 12 includes a data processing part 15 for processing the data to  
25        be transmitted or received, and a transmitting and receiving

component 16 for transmitting and receiving the data.

Numerals 20 denotes the configuration of an information center. The information center 20 includes a center communication unit 21 for communicating with a communication unit 21 mounted on the vehicle, a storage unit 23 for storing or accumulating in real time various kinds of information, including the map information and the facility information, the traffic information such as congestion information, the regulation information and accident information on the road, the weather information such as the current weather in each district and the weather forecast, event information held in each district at present or in the future, and a center control unit 22 that functions as a center communication unit control part for controlling the center communication unit 21 to make the communication, functions as a reading control part for controlling reading various kinds of information from the storage unit 23, and functions as a calculation part for calculating the drive route of the vehicle.

As described above, in the navigation system composed of the navigation terminal 10 and the information center 20, various kinds of request commands are transmitted from the navigation terminal 10 to the information center 20 via a communication line connecting the communication unit 12 and the center communication unit 21, and various kinds of information are transmitted from the information center 20 to

the navigation terminal 10 in response to commands.

A portable telephone service system and a PHS telephone service system are available for the line connecting the communication unit 12 and the center communication unit 21.

5 Examples of the request command sent from the navigation terminal 10 to the information center 20 may include various kinds of information acquisition commands and functional commands, such as a map request command for acquiring the map information, a route calculation request command for calculating the drive

10 route, a retrieval request command for retrieving a facility or a point, and an information request command for acquiring various kinds of information such as traffic information.

Herein, the map request command will be detailed below. The control unit 13 outputs the map request information including

15 the current location information and the map scale information based on the current location of the vehicle positioned by the positioning unit 14 to the data processing part 15. After various kinds of information is converted into a predetermined format in the data processing part 15, the map request command is

20 transmitted via the transmitting and receiving component 16 to the information center 20.

In the information center 20, the center control unit 22 reads out the map information from the storage unit 23 in response to the map request command acquired via the line

25 connecting the communication unit 12 and the center

communication unit 21, and transmits the read map information via the line to the navigation terminal 10.

At the navigation terminal 10, a map is displayed on the display unit 11, based on the map information acquired via the line by the communication unit 12. The control part 13 includes  
5 a temporary storage unit 17 for storing the information, whereby various kinds of information acquired from the information center 20, including the map information, is stored and held, as long as they are deleted positively upon an instruction of  
10 the user.

A route calculation request command will be detailed below. At the navigation terminal 10, a plurality of screens for enabling the user to decide the place of departure and the place of destination are switched and displayed in succession on the  
15 display unit in accordance with a user's operation under the control of the control unit 13.

When the user operates the operation unit 18 on the display by switching it, the place of departure and the place of destination, with the way point, are decided. Herein, the place  
20 of departure is the current location of the vehicle positioned by the positioning unit 14 at the decision time, unless the user designates a predetermined point specifically. That is, when the user only decides the place of destination by operating the operation unit, it is judged to acquire the route leading  
25 from the current location to the place of destination. The

control unit 13 outputs the route calculation request command information, including the departure point information, the destination point information, the bypath point information and the route calculation condition information to the data processing part 15, based on the information in each district, whereby the route calculation request command information is converted into a predetermined format in the data processing part 15, and transmitted as a route calculation request command via the transmitting and receiving component 16 to the information center 20.

In the destination point information, a retrieval request command relating the telephone number information and the postal code information for retrieving the facility or point is transmitted from the navigation terminal 10 to the information center 20. In the information center 20, the detailed information of the facility or point is retrieved from the storage unit 23, based on its information. The navigation terminal 10 acquires the retrieved detailed information, whereby the acquired detailed information is utilized.

At this time, the control unit 13 determines whether or not the line connecting the communication unit 12 and the center communication unit 21 is established. And when established, the route calculation request command is directly transmitted from the navigation terminal 10 to the information center 20.

On the other hand, if the control unit 13 determines that



the line connecting the communication unit 12 and the center communication unit 21 is not established, first of all, the control unit 13 functions as a connection control unit for controlling the communication unit 12, and starts a connection  
5 process for the line connecting the communication unit 12 and the center communication unit 21. Thereafter, when the connection of the line is established, the information indicating the current location of the vehicle is acquired again from the positioning unit 14 at that time, and this information  
10 indicating the current location as the departure point information, together with the destination point information, the bypath point information and the route calculation condition information, is transmitted as the route calculation request command information.

15 The information center 20 calculates the optical drive route from the map information that the center control unit 22 reads from the storage unit 23, the departure point information, the destination point information and the bypath point information, and the route calculation condition  
20 information, on the basis of the route calculation request command acquired via the line connecting the communication unit 12 and the center communication unit 21. And the drive route information based on the calculated drive route and the map information around the peripheral district including its route  
25 are read from the storage unit 23, and transmitted via the line

to the navigation terminal 10 at the same time.

At the navigation terminal 10, a map in which the drive route is superposed on the display unit 11 is displayed for the drive guide, based on the drive route information that the communication unit 12 acquires via the line and the map information around the peripheral district including its route. This drive route information and the map information around the peripheral district including its route are stored and held in the temporary storage unit 17 within the control part 13.

10 As another example of transmitting the route calculation request command, when the actual driving of the vehicle deviates from the drive route based on the drive route information acquired as described above, the current location after deviation is defined as the new departure point information, 15 and the departure point information, the destination point information, the bypath point information and the route calculation condition information are automatically transmitted as the route calculation request command.

Moreover, when an interference of traffic such as a traffic 20 congestion or accident is detected to take place on the drive route based on the drive route information acquired, according to the traffic information acquired separately from the information center 20, a new condition for excluding the route where the interference of traffic takes place is added as the 25 route calculation condition, and this route calculation

condition information, the departure point information at that time, the destination point information, and the bypath point information are automatically transmitted again as the route calculation request command.

5           As described above, in the case where the route calculation request command is automatically transmitted when the vehicle deviates from the drive route, or when the interference of traffic such as traffic congestion or accident is detected to take place on the drive route, the control unit 13 determines  
10 whether or not the line connecting the communication unit 12 and the center communication unit 21 is established at that time. And when established, the route calculation request command is automatically transmitted from the navigation terminal 10 to the information center 20 at once.

15           On the other hand, the control unit 13 determines that the line connecting the communication unit 12 and the center communication unit 21 is not established, first of all, the control unit 13 functions as a connection control unit for controlling the communication unit 12, and starts a connection  
20 process for the line connecting the communication unit 12 and the center communication unit 21. Thereafter, when the connection of the line is established, the information indicating the current location of the vehicle is acquired again from the positioning unit 14 at that time, and this information  
25 indicating the current location as the departure point

information, together with the destination point information, the way point information and the route calculation condition information, is transmitted as the route calculation request command information.

5           The drive guide made by the drive guide unit (control unit 13) at the navigation terminal 10 will be detailed below. The control unit 13 makes the drive guide on the basis of the drive route information stored and held in the temporary storage unit 17 and the information indicating the current location  
10 of the vehicle positioned by the positioning unit 14. As this drive guide, the map is superposed with a drive route mark (drive road with color) according to the drive route information on the screen of a display unit 11, or displayed in a format in which a branch point is provided with the arrow indicating the  
15 driving direction or the branch point is enlarged, when the vehicle arrives near the branch point on the drive route. Or the driving direction or the building as the landmark may be output in voice.

          In the route search function service as described above,  
20 when the drive route information is received at the terminal mounted on the vehicle, the total drive route information indicating the drive route connecting the place of departure and the place of destination is received at a time. At this time, if the control unit 13 as the drive guide unit determines  
25 that the information of a partial drive route in the total drive

route connecting the place of destination and the place of departure is received, the drive guide is started based on the received information of the partial drive route.

As the requirements for the partial drive route information suitable for practicing the drive guide based on the information of this partial drive route, the drive route information preferably includes at least one branch point from near the place of departure. Also, this one branch point preferably involves the branch point information nearest the place of departure on the drive route. Moreover, when the line is disconnected on the way, or the entire drive route information is not received due to insufficient storage capacity of the navigation terminal 10, the drive route of the received drive route information up to the branch point located at the farthest point from the place of departure on the drive route is utilized as the effective partial drive route information.

When the partial drive route information meeting such requirements is received, the drive guide is started at once, supporting the present driving near the place of departure. Moreover, the control unit 13 makes a process for receiving the remaining drive route information regarding the remaining drive route, while conducting the drive guide. As one example of this process, the process for receiving the remaining drive route information may be started immediately after the line is disconnected. As another example, when the vehicle arrives

near the branch point located at the farthest point from the place of departure on the drive route, which the received information of the partial drive route indicates, the process for receiving the remaining drive route information may be  
5 started.

The information request command will be detailed below. At the navigation terminal 10, a plurality of screens are switched and displayed in succession on the display unit 11 in accordance with the operation of the user under the control  
10 of the control part 13 to enable the user to enter the type of required information. The types of information may include the traffic information such as congestion information, regulation information and accident information on the road, the weather information such as the current weather in each  
15 district and the weather forecast, and the event information held at present or in the future in each district.

And the control unit 13 outputs the information indicating the type of information input by the user and the district information indicating the required district (e.g., current  
20 position information, destination point information, and position information indicating the point or district designated by the user) to the data processing part 15, converted into a predetermined format in the data processing part 15, and transmitted as the information request command via the  
25 transmitting and receiving component 16 to the information

center 20.

In the information center 20, the center control unit 22 reads the detailed information consistent with the type of information contained in the information request command from the storage unit 23, upon the information request command acquired via the line connecting the communication unit 12 and the center communication unit 21, and transmits it to the navigation terminal 10 via the line.

At the navigation terminal 10, the detailed information is displayed on the display unit 11, based on the detailed information acquired via the line by the communication unit 12, and when a map display command is input by the user, the map with a mark (congestion mark, accident mark, weather mark, or event mark) for the information superposed is displayed on the display unit 11, based on the detailed information of the facility and the acquired map information. This detailed information is stored and held in the temporary storage unit 17 within the control part 13. Also, the drive trouble such as congestion or accident on the drive route is detected, employing the acquired traffic information.

Referring to Fig. 2, a few examples are given below.

Fig. 2 is a flowchart showing a process for performing the drive guide in which the control unit 13 for the navigation terminal 10 mounted on the vehicle transmits a route calculation request command via the line connecting the navigation terminal

10 and the information center 20, and receives the drive route information from the information center 20.

First of all, at step S1, the departure point information, the destination point information (way point information as  
5 required) and the route calculation condition information as the route calculation request command information are decided. Herein, the decision includes the following cases.

That is, when the route is firstly acquired, the user designates the departure point information, the destination  
10 point information (way point information as required) and the route calculation condition information for the first time. At this time, the information indicating the current location of the vehicle positioned by the positioning unit 14 at the decision time is defined as the departure point information,  
15 unless the user particularly specifies a predetermined point as the place of departure.

Also, in the case where the drive route information is already acquired and employed, to automatically transmit a route calculation request command when the vehicle deviates from the  
20 drive route or the drive trouble such as congestion or accident takes place on the drive route, the destination point information (way point information as required) and the route calculation condition information are directly employed from the information decided in acquiring the route for the first time,  
25 and the departure point information is employed from the



information indicating the current location of the vehicle acquired from the positioning unit 14.

Subsequently, a process for transmitting the route calculation request command information is started (step S2),  
5 and it is determined whether or not the connection of the line with the information center 20 is completed (the line is established). If the connection of the line is not completed (the line is not established), a connecting process with the information center 20 is continued or newly started, whereby  
10 the connection of the line is completed (the line is established). If it took some time to connect the line, the information indicating the current location of the vehicle is acquired from the positioning unit 14 and set as the departure point information again, when the connection of the line is completed  
15 (the line is established).

And the route calculation request command information including this new departure point information is transmitted via the connected line to the information center 20 (step S3).

Subsequently, a process for receiving the drive route  
20 information transmitted from the information center 20 is started (step S3). This receiving process may be made while the connection state of the line is maintained, or the line connection may be restarted upon a trigger from the information center 20 after suspending for a while.

25 If the receiving process is started, the reception of

the drive route information is then confirmed (step S5). Then, it is determined whether or not the received drive route information is the drive route up to the place of destination (step S6). That is, at step S6, it is determined whether the  
5 received drive route information involves the total drive route from the departure point to the destination point or its partial drive route. Also, at step S6, it is determined whether or not the received information of the partial drive route satisfies the above condition. In this determination, if the above  
10 condition is not satisfied, the transfer process is stopped, and the procedure goes to step S1 again to start the procedure anew.

At step S6, if the information of partial drive route is received, the drive guide is started based on the received  
15 partial drive route (step S7).

Subsequently, the vehicle is moved along with the drive guide, and it is determined whether or not the vehicle has arrived near the branch point located at the farthest point from the departure point on the drive route indicated by the information  
20 of partial drive route (step S8). Herein, if the vehicle has not arrived, the procedure goes to step S7 to continue the drive guide based on the information of partial drive route.

On the other hand, if the vehicle has arrived near the branch point, a process for receiving the remaining drive route  
25 information is performed by deciding again the route calculation

request command information, including the departure point information, the destination point information (way point information as required) and the route calculation condition information (step S9). At this time, the departure point  
5 information is the information indicating the current location of the vehicle positioned by the positioning unit 14 at that time.

Thereafter, the procedure goes to step S2 again to perform the above procedure. And the same procedure is repeated until  
10 it is determined that the received drive route information is the total drive route information at step S6 again.

If it is determined that the received drive route information is the total drive route information at step S6, the drive guide is started based on the information of the total  
15 drive route (step S10).

Subsequently, the vehicle is moved along with the drive guide, and it is determined whether or not the vehicle has arrived near the place of destination on the drive route indicated by the information of total drive route (step S11). Herein, if  
20 the vehicle has not arrived, the procedure goes to step S10 to continue the drive guide based on the information of total drive route.

If the vehicle has arrived near the place of destination, the route guide is finished and the procedure in series is ended.

25 As described above, in this example, it is determined

whether or not the received drive route information involves the total drive route from the departure point to the destination point, or its partial drive route. If the partial drive route information is received, the drive guide is immediately started,  
5 based on the received information of partial drive route, making it possible to support the driving near the place of departure at once.

In the above example, at step S9, the new departure point information, as well as the destination point information (way  
10 point information as required) and the route calculation condition information again are transmitted. However, when the destination point information (way point information as required) and the route calculation condition information are transmitted as the route calculation request command  
15 information to the information center 20 for the first time, they are stored together with the information identifying the navigation terminal 10 in the information center 20, and the information stored is employed when the drive route is acquired.

In this manner, in acquiring the new drive route, the  
20 new departure point information alone is transmitted as the route calculation request command information to the information center 20, whereby the amount of information to be transmitted is decreased, and the time necessary for communication or the communication cost is reduced.

25 Also, when the route calculation request command

information is transmitted from the navigation terminal 10,  
the information indicating the storable capacity of information  
within the navigation terminal 10 is transmitted at the same  
time, whereby the information center 20 can transmit the drive  
5 route information having the information amount corresponding  
to the storable capacity of information.

Also, in consideration of the possibility that the line  
is disconnected on the way, the drive route information near  
the place of departure is firstly transmitted from the  
10 information center 20, whereby when the information of partial  
drive route is received, the drive guide near the place of  
departure is securely conducted to support the driving.

Also, in the above example, at step S8, the vehicle is  
moved along with the drive guide, and it is determined whether  
15 or not the vehicle has arrived near the branch point located  
at the farthest point from the departure point on the drive  
route indicated by the information of partial drive route. If  
the vehicle has arrived near the branch point, a process for  
receiving the remaining drive route information is performed  
20 by deciding again the route calculation request command  
information, including the departure point information, the  
destination point information (way point information as  
required) and the route calculation condition information (step  
S9). If the vehicle is moved not near the branch point but in  
25 an area full distance from the branch point (e.g., within 100

km around the branch point as the center), the process for receiving the remaining drive route information (step S9) may be performed. In this case, even if the communication line is not connected, the process for connecting the communication  
5 line may be repeated several times, while the drive guide is continued based on the received information of partial drive route.

In the embodiment and example as described above, the device is mounted on the vehicle. However, this invention is  
10 also applicable to the portable telephone terminal having the positioning unit mounted or the system using the terminal unit.

In the embodiment and example as described above, the computer program may be configured to enable the computer to perform the same functions.